

***Final Draft
Remedial Investigation/
Feasibility Study Work Plan
Former Pacific Powder Site
Maytown, Washington***

***Prepared for
Citifor, Inc.***

***November 2004
7723-03***

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CONTENTS

Page

1.0 PROJECT OVERVIEW	1-1
1.1 Introduction	1-1
1.2 Previous Environmental Investigations	1-4
1.3 Hydrogeologic Conditions	1-13
1.4 Objectives	1-14
1.5 Scope of Work Elements	1-15
1.6 Schedule	1-18
 2.0 SAMPLING AND ANALYSIS PLAN	 2-1
2.1 Soil Quality Investigation	2-3
2.2 Groundwater Quality Investigation	2-21
2.3 Sampling Methodologies	2-24
2.4 Sample Documentation and Handling Procedures	2-27
2.5 Decontamination and Investigative-Derived Waste Procedures	2-28
 3.0 QUALITY ASSURANCE PROJECT PLAN	 3-1
3.1 Analytical Procedures	3-1
3.2 Data Quality Indicators	3-2
3.3 Quality Control Procedures	3-3
3.4 Corrective Actions	3-4
3.5 Data Reduction, Quality Review, and Reporting	3-5
3.6 Preventive Maintenance Procedures and Schedules	3-6
3.7 Performance and System Audits	3-7
3.8 QC Reports to Management	3-7
3.9 References for Section 3	3-7
 4.0 HEALTH AND SAFETY PLAN	 4-1
4.1 Emergency Contingency Information	4-1
4.2 Site Health and Safety Plan Summary	4-3
4.3 Introduction	4-3
4.4 Hazard Evaluation and Control Measures	4-7
4.5 Personal Protective Equipment (PPE)	4-20
4.6 Safety Equipment List	4-22
4.7 Exclusion Areas	4-23
4.8 Minimization of Contamination	4-24

CONTENTS (Continued)

Page

4.9 Decontamination	4-24
4.10 Disposal of Contaminated Materials	4-27
4.11 Site Security and Control	4-27
4.12 Spill Containment	4-27
4.13 Emergency Response Plan	4-28
4.14 Medical Surveillance	4-31
4.15 Training Requirements	4-32
4.16 Reporting, Reports, and Documentation	4-32

TABLES

2-1	Planned Soil Quality Samples and Analyses
2-2	Groundwater Quality Samples and Analyses
3-1	Comparison of Soil Reporting Limit Goals to Preliminary Screening Criteria
3-2	Comparison of Groundwater Reporting Limit Goals to Preliminary Screening Criteria
3-3	Sample Container, Preservative, and Holding Times
4-1	Location of Required Health and Safety Plan Elements in This Site-Specific H&S Plan
4-2	Air Monitoring Action Levels
4-3	Hazard Analysis by Task
4-4	Minimum Personal Protective Equipment Level Requirements
4-5	Record of Health and Safety Communication

FIGURES

1-1	Site and Surrounding Area Plan
1-2	2001 Aerial Photograph
1-3	Site Plan – Former Explosives Plant (1940-1964)
1-4	Site Plan – Former Explosives Plant (1965-1968)
1-5	Site Plan – Former Explosives Plant (1969-1994)
1-6	Excavation and Groundwater Well Location Plan
1-7	Site Plan and Groundwater Elevation Contour Map
2-1	Surface Soil Sampling Plan
2-2	Draft Groundwater Sampling Plan
4-1	Emergency Route to Hospital Map
4-2	Decontamination Layout
4-3	Field Health and Safety Report

CONTENTS (Continued)

Page

**APPENDIX A
RESPONSE TO ECOLOGY COMMENTS ON
REMEDIAL INVESTIGATION/FEASIBILITY STUDY SCOPING PLAN**

**APPENDIX B
STL LABORATORY QUALITY CONTROL CRITERIA**

**APPENDIX C
EXPLOSIVE HAZARD ASSESSMENT (EHA)**

REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

FORMER PACIFIC POWDER SITE

MAYTOWN, WASHINGTON

This Remedial Investigation/Feasibility Study (RI/FS) Work Plan describes proposed field investigation tasks that will be used to characterize environmental conditions at the Former Pacific Powder site. The Former Pacific Powder site is located near Maytown, Washington (see Figure 1-1 for location). The RI/FS will be conducted pursuant to an Agreed Order to be negotiated with the Washington State Department of Ecology (Ecology).

This Work Plan (Plan) has been developed in accordance with WAC 173-340-350. A preliminary Remedial Investigation/Feasibility Study Scoping Plan (dated September 11, 2003) was developed by Hart Crowser and submitted for Ecology review. Ecology issued written comments to the Scoping Plan on December 11, 2003, and they were discussed at a meeting held at Ecology's Southwest Regional office on December 15, 2003. Results of these discussions were used to develop this Plan. Written responses to Ecology's comments are presented in Appendix A.

This Plan consists of four sections:

- **1.0 PROJECT OVERVIEW** describes the project background, objectives, scope of work elements, and organization.
- **2.0 SAMPLING AND ANALYSIS PLAN** provides an overview of the rationale and methods to be used for the RI sampling and analysis. The intent of this sampling and analysis program is to define the nature and extent of contamination for the purpose of developing and evaluating cleanup action alternatives under the Washington State Model Toxics Control Act (MTCA).
- **3.0 QUALITY ASSURANCE PROJECT PLAN** presents the general and specific steps to be taken throughout the course of this program to ensure that the data satisfy minimum quality assurance requirements and are scientifically defensible.
- **4.0 HEALTH AND SAFETY PLAN** addresses procedures to minimize chemical exposure risks and to prevent physical accidents for on-site workers. The plan includes sections on site hazards, levels of protection, work zones, personnel and equipment decontamination, emergency facilities, and chemical exposure systems.

These sections are supported by tables and figures which are numbered according to and presented at the end of, their respective sections except for Section 4, where tables and figures are inserted throughout the text. Further, the report contains three appendices, titled:

- Appendix A - Response to Ecology Comments on Remedial Investigation/ Feasibility Study Scoping Plan;
- Appendix B - STL Laboratory Quality Control Criteria; and
- Appendix C - Explosive Hazard Assessment (EHA).

1.0 PROJECT OVERVIEW

1.1 Introduction

1.1.1 Site Description

The approximately 1,625-acre subject property is located east of Tilley Road approximately 2 miles east of Maytown (Figure 1-1). The property is generally flat, with hillsides located on the northern and southern edges. The majority of the property is undeveloped and covered by brush and woodlands (Figure 1-2). Beaver Creek, running east to west along the southern end of the property, is surrounded by wetlands. A smaller creek (Allen Creek) drains the northwest portion of the property.

A small portion of the property was occupied by a dynamite manufacturing plant from the early 1940s until 1968. For the majority of its operational history (approximately 1942 through 1964), the former Pacific Powder plant (Powder Plant) was limited to the north central portion of the property and consisted of less than 100 acres of land and leased magazine space from adjacent property owners (Figure 1-1). In 1965, the Hercules Powder Company (Hercules) purchased approximately 1,600 acres of land surrounding the plant. However, manufacturing activities remained limited to the north central 100-acre portion of the property. From the late 1960s until 1994, Ammonium Nitrate Fuel Oil (ANFO - a mixture of ammonium nitrate and fuel oil) and slurry explosives were manufactured within the Powder Plant and Monoethanolamine Nitrate (MEAN) plant areas. A culvert production facility (Culvert Plant) located west of the Powder Plant Area operated from approximately 1976 through the mid-1980s.

Many buildings located in the areas identified on Figure 1-1 as the Powder Plant and Culvert Plant are still present and are typically constructed of metal with concrete foundations (some wood and brick structures are also present). Most of the buildings located in the Old and New Nitrator areas, the MEAN Plant, labs, and various powder line buildings (e.g., dynamite and gelatin houses) have been demolished and are overgrown with dense brush (Scotch Broom). Very little evidence (e.g., foundations, demolition debris) of these former structures is currently visible. Woodlands, scattered residential homes, and pastures surround the property. The Tacoma Western Railway right of way crosses the north end of the property.

1.1.2 Historical Land Use

Figures 1-3 through 1-5 show known site features as they existed during the approximate time period identified on the figures.

The Pacific Powder Company (Pacific Powder I) plant was built in the early 1940s to produce dynamite. At that time, a farmhouse and associated farm buildings appear on the property near Tilley Road. The plant property was approximately 100 acres in area prior to 1964. The plant had one dynamite production line throughout this period. The plant included the Powder Plant (at least 15 separate structures), a nitrator (identified as the Old Nitrator Area on Figure 1-3), mix and neutralizer houses, dynamite and gelatin houses, box and case pack houses, DNT melting house (exact location currently unknown), a laboratory (identified as EGD Lab on Figure 1-3), and a burn pit (identified as Pacific Powder I [PPI] Burn Pit on Figure 1-3). A narrow gauge railroad was used to transport materials across much of the plant area. Batches of nitroglycerin reportedly moved by gravity flow through a gutter system from the Nitrator House to the Neutralizer House. Rubber-tired buggies were used for the transport of nitroglycerin from the Neutralizer House to the Mix House.

Four magazines reportedly constructed of wood were used to store finished products in areas leased from adjacent property owners (identified as Magazines 1, 2, 3, and 4 on Figure 1-1). Other buildings on the site, consisting of at least one earthen covered Quonset hut and small block houses, were used to store detonators that were manufactured elsewhere and stored. A relatively small bermed area northwest of Magazine 1 was originally identified as Magazine 2 in the Hart Crowser Phase I report produced in February of 2003. However, a schematic drawing (not to scale) produced by Dyno Nobel indicated that a magazine was located in the southeastern corner of the property as depicted on Figure 1-1. Review of aerial photographs indicate that a structure was present in this area. A March 26, 2004, interview and site visit conducted with Ken Dunkin, a current Alaska Pacific Powder Company (APPCO) employee who worked at the site from 1983 to 1994, indicated that the Magazine 2 location was used for detonator storage.

In 1964, Hercules purchased the property from Pacific Powder I, and continued to manufacture dynamite. Hercules purchased surrounding land that increased the property to the present size of approximately 1,625 acres, but the vast majority of this additional land was not used in the manufacturing process nor otherwise developed. Manufacturing activities remained primarily within the north central 100-acre portion of the property. By 1965, Hercules had constructed a square-fenced burn pit southeast of the Pacific Powder I Burn Pit

(identified as 1960s-Era Hercules Burn Pit on Figure 1-4) and a laboratory located northwest of the Mix House (Figure 1-4). By 1968, the Hercules plant included a new nitrator facility (identified as New Nitrator Area on Figure 1-4) located approximately 600 feet south of the Old Nitrator Area. Acid and glycol tanks were constructed approximately 400 feet west of the New Nitrator Area. In the late 1960s, a plant later known as the MEAN Plant was constructed for production of ANFO. A standard gauge railroad spur was also constructed to serve the MEAN Plant. Hercules closed the dynamite plant in 1968.

In approximately 1969, former Hercules salesman William Garson incorporated Pacific Powder Pipe & Supply, Inc. (designated in this report as PPP&S) and leased the property from Hercules in 1970. PPP&S later became known as PACCO. In the late 1970s to the mid-1980s, ANFO production was moved to the large building in the Powder Plant Area (Building 9 shown on Figure 1-5). After ANFO production was moved, MEAN (a slurry explosive) was manufactured at the MEAN Plant. According to a September 7, 1993, memorandum issued by Dyno employee Dale Patton, MEAN Plant operations were discontinued in 1985 or 1986. Production of ANFO within the Powder Plant Area continued until approximately 1993.

By 1970, the 1960s-Era Hercules Burn Pit was no longer in use and was covered with grass. However, disturbed soil is visible in historical aerial photographs east of the Pacific Powder I Burn Pit in areas later identified as the Drum Burial Area and Alleged Burial Site (ABS) Landfill (Figure 1-5). The ABS Landfill area includes a landfill/burn area that was reportedly used for disposal of garbage during the 1970s and 1980s. The 1977 aerial photo shows two newer burning grounds located 1,200 feet east of the MEAN Plant (identified as the 1970s-Era Fireworks Burn Pits on Figure 1-5). One of the burning grounds was reportedly used by law enforcement agencies for destruction of contraband fireworks.

A Culvert Plant was located 1,500 feet east of the Former Hercules Office (Caretaker Residence on Figure 1-1) and operated from approximately 1976 through the mid-1980s. This operation was owned by PPP&S but was not directly related to the explosives plant. However, some tanker trucks used the Culvert Plant area for parking. Treated steel culvert was manufactured by rolling and welding steel in the building identified as Warehouse on Figure 1-5, and dipping the steel culverts in asphalt/tar in the Dipping Building.

Hercules sold the subject property to Ireco, Inc. (the predecessor of Dyno Nobel, Inc.) in May 1985. According to a 1994 environmental cleanup report prepared by Dyno Nobel (Dyno Nobel 1994), Ireco purchased PPP&S in 1988. Dyno Nobel (Dyno) sold the property to Citifor Inc. in 1993. Dyno's 1994

report indicates that it leased a portion of the property from Citifor for one year and sub-leased it to its distributor (Alaska Pacific Powder Company [APPCO]). Dyno decommissioned the plant in late 1994.

When Citifor purchased the property in 1993, Dyno conducted an environmental investigation and cleanup program. Details of Dyno's cleanup activities are discussed in Section 1.2. Following purchase of the property, Citifor logged the site in preparation for redevelopment. During clearing operations in late 1997, buried drums were encountered at the Drum Burial Area. Excavation and cleanup activities conducted in the Drum Burial Area are discussed in Section 1.2.

Some details of the historical land use interpretation may change based on review of records that may be obtained from Dyno Nobel or other parties in response to Ecology information requests. Any changes will be incorporated into the final Work Plan.

1.2 Previous Environmental Investigations

Several environmental investigations and cleanup actions have been conducted on the site since the late 1980s.

Culvert Plant, 1989. Liquid storage drums had leaked oil through a trailer floor and onto soil in an area of about 330 square feet at the Culvert Plant. The soil contained "non-hazardous" motor oil, hydraulic oil, and mineral spirits. Sweet Edwards/EMCON removed soils with petroleum odors within a 22- by 15-foot area (Sweet Edwards/EMCON 1989). Some verification samples collected in May 1989 had concentrations of total petroleum hydrocarbons (TPH) ranging from 600 to 3,000 mg/kg. Three test pits were excavated in June 1989. Sampling and analysis indicated that TPH contamination in soil attenuated rapidly with depth. Additional soil was excavated to depths of 8 to 12 feet below ground surface. Verification soil samples collected along the side walls and bottom of the excavation did not contain TPH concentrations in excess of 200 mg/kg. Final cleanup documentation was submitted to Mr. Paul Sonnenfeld of Ecology in a letter dated November 21, 1989.

Powder Plant UST Removal, 1989. Three underground storage tanks (USTs) were decommissioned and removed from the Powder Plant area in 1989 by Joe Hall Construction. Two of the tanks were old railroad tank cars used to store diesel and were located south of the main plant building (Figure 1-5). The third tank was a 2,000-gallon gasoline UST located in the northeastern corner of the Powder Plant Area. Over 1,400 cubic yards of petroleum-impacted soils were

removed from the tank excavations. According to a September 20, 1989, letter from Pacco to Mr. Dick Walker of Ecology, final verification samples collected from the side walls and bottoms of the excavations contained TPH concentrations of less than 30 mg/kg.

Dyno Nobel Site Wide Cleanup, 1990 to 1995. Twenty-nine "environmental units" were identified and investigated by Dyno. Many of these units were located in the Powder Plant Area. Results of Dyno's investigations and cleanup actions were summarized in two reports (Campbell and Dunkin 1994 and Dunkin 1995). Dyno encountered and removed thousands of cubic yards of petroleum-impacted soils adjacent to Powder Plant area sumps, tanks, oil/water separators, drain oil pits, a wood basin near the Truck/Diesel Shop (Building 13), and a diesel line trench at the Diesel AST (Building 20).

TPH-impacted soils were also encountered and removed from the Culvert Plant and the ABS Landfill Area (located just southeast of the Drum Burial Area). The Culvert Plant cleanup included removal of petroleum-impacted soil around the "dipping plant." Some soil was also removed from a stormwater culvert outfall south of the Culvert Plant. Based on the analytical data collected by Dyno, their cleanup activities were successful at removing petroleum-impacted soils at the ABS Landfill. However, elevated metals concentrations were also detected in several soil samples, including cadmium (up to 4.3 mg/kg) and lead (up to 670 mg/kg). Surveyed locations of these soil samples were not provided in the 1995 report.

A large volume of diesel-impacted soil was also excavated at the MEAN Plant. Although soil volume calculations were not provided in the report, excavation maps and verification soil sample analytical results indicate that the diesel contamination was present to depths of up to 27 feet below ground surface. Dyno's consultant (Conrex) installed three monitoring wells at locations surrounding the area of petroleum-impacted soil. No diesel-range hydrocarbons were detected in groundwater samples collected from these wells. The soil excavated at the MEAN Plant was bioremediated on site by Olympic Environmental.

Dyno also evaluated environmental conditions in two areas located southeast of Magazine 3 identified as the Farm House Burn Pit and Seismic Pond (Figure 1-5). Burned caps and copper wire were encountered in a small (10- by 10- by 4-foot) pit located next to the old farmhouse site. Dyno stated in its 1994 cleanup report that although it appeared that old electronic detonators were burned in the pit, excavation and testing activities did not encounter "hazardous contaminants." Dyno's 1994 cleanup report mentioned the presence of a

seismic pond that was used for testing the quality and reliability of explosives manufactured at the Pacific Powder plant. The exact location and size of the pond were not presented in the report but Dyno's schematic diagram indicated that it was present in the general area northwest of the Farm House Burn Pit (Figure 1-5). Ken Dunkin of APPCO indicated that the Seismic Pond consisted of a small semi-circular depression located at the edge of the wetland area. Ken stated that sediment at the bottom of the pond was removed and disposed of off site during cleanup. Dyno's reports stated that the Seismic Pond area was clean, and that soil was being graded away from a wetland.

As part of the cleanup program, Dyno demolished four magazines by burning them in accordance with procedures negotiated with the Olympic Air Pollution Control Authority and the Little Rock Fire Department. Dyno reported that the magazines were constructed with wood flooring and walls (according to Ken Dunkin, Magazine 1 had concrete flooring). Following the demolition burning of the magazines, a composite sample of the residual burned ash material was tested for metals and contained only 23 mg/kg of lead. The ash material was disposed of at an off-site facility.

Dyno's reports also indicated that in August 1990, the property's five transformers were tested for PCB content. Samples of oil from two transformers at the MEAN Plant contained 219 and 636 ppm PCB. The oil in these transformers was drained and replaced with non-PCB-containing oil.

Well Water Testing, 1996 to 1997. Under contract to George Heidgerken, Robinson and Nobel sampled nine of ten wells for conventional parameters (e.g., alkalinity, hardness, nitrate, and conductivity) on the property and evaluated pumping rates (Robinson and Nobel 1996). High chloride and mineralization were detected in the eastern wells. "Good" water quality was reported on the downgradient western side, though Well PP#4 had a pH of 5.5 and Wells PP#1 and PP#3 had pH measurements of 6. Wells PP#7 and PP#8, located east and southeast of the plant (Figure 1-5), had "low quality water" with elevated chloride and minerals (high conductivity). Well PP#5, located within the Powder Plant area, had very high chloride (similar to seawater levels), 10 percent dissolved solids, and contained oily/waxy "blobs."

Pacific Groundwater Group (PGG) performed an evaluation of groundwater quality in the vicinity of well PP#5 (Pacific Groundwater Group 1997). In July of 1997, PGG performed a slug test in the well and determined that it was not in good hydraulic continuity with the aquifer. The bottom of the well was also apparently plugged by fine black sediment. PGG concluded that this finding was consistent with PP#5's reported use as a grounding well rather than a supply

well. Lightning rod grounding wells are treated with salt to increase electrical conductivity to attract lightning away from nearby buildings.

To verify that the elevated chloride and dissolved solids concentrations were limited to water within the PP#5 casing, PPG monitored conductivity in water samples collected at 5-foot-depth intervals within a boring installed adjacent to the grounding well. Conductivity readings in groundwater adjacent to PP#5 were similar to other areas within the Pacific Powder property and did not appear to contain salt.

Conrex/AETS Drum Burial Area Waste Characterization, 1997 to 1998. During logging operations in late 1997, buried drums were encountered at the Drum Burial Area (Figures 1-1 and 1-6). In early 1998 Conrex, under contract with Dyno, performed a site investigation to identify drum burial locations and define the nature and extent of soil contamination resulting from the buried drums. The first phase of the investigation included a magnetometer survey within three 200-foot diameter circles around locations of drums exposed during logging. Each location where a magnetic anomaly was recorded (indicating presence of ferrous metal) was excavated by hand to determine if drums were present. Confirmed locations of drums were marked for excavation. Some drums were labeled dinitrotoluene (DNT) and three appeared to contain residual DNT. Drums were excavated from the upper 2 feet of soil in three areas identified as Excavations 1, 2, and 3 on Figure 1-6. Soil in the area was contaminated with nitroaromatic compounds including DNT. Contaminated soil was stockpiled southwest of the excavations.

In April 1998, AETS, currently doing business as ONYX, was contracted to assist Dyno with additional drum and soil removal and to transport contaminated drums off site for proper disposal. AETS began trenching in the vicinity of previous excavations and discovered more drums buried north of Excavation 3. This new buried drum location is identified as Excavation 3A on Figure 1-6. AETS removed drums as they were discovered, collected soil samples from some of the trenches and excavations, and submitted the samples for analysis of nitroamine/nitroaromatic compounds (EPA Method 8330). Constituents of concern identified in site soils included isomers of DNT, trinitrotoluene (TNT), and nitrotoluene. The isomers of DNT, specifically 2,4-DNT and 2,6-DNT, were the most commonly detected compounds at the site. For the purpose of this RI/FS Work Plan, total DNT is defined as the sum of the 2,4-DNT and 2,6-DNT concentrations.

Based on the results of analysis, additional excavation was performed in Excavations 1, 2, 3, and 3A, and the soil was stockpiled on site. AETS packaged

and transported most of the drums and associated debris for off-site disposal before it stopped work in late 1998 or early 1999.

Thurston County Health Department Review, 1998. In response to the discovery of buried drums on site, six surrounding area drinking water wells were sampled and analyzed by Ecology and Thurston County Health Department in 1998. Groundwater samples collected from the wells were analyzed for volatile and semivolatile organics, nitroaromatics and nitroamines, metals, and nitrate/nitrite. Sample analytical results for the wells were acceptable based on drinking water standards except for two wells located on 143rd Street that contained pentachlorophenol (PCP or penta) above state and federal drinking water standards. The six wells, plus ten other area wells, were then resampled. None of the sixteen wells contained penta. The two wells where penta had been detected were resampled a third time, and again no penta was detected. Ecology and Thurston County Health Department concluded that the groundwater from the wells was safe to drink.

Hart Crowser Drum Burial Area Investigations, 1999 to 2003. Hart Crowser became involved with the Drum Burial Area in August 1999 under contract to Citifor and completed the following tasks:

- Covered the soil stockpiles with heavy plastic and placed a plastic liner in Excavation 3 (December 1999);
- Assisted Citifor in transporting remaining drums and debris from the site through a contract with AETS (October through December 1999);
- Collected and analyzed soil samples from excavations and trenches not previously sampled by AETS to fill data gaps (October 1999);
- Completed a cleanup action objective and focused feasibility study (Hart Crowser 2000);
- Installed four groundwater monitoring wells (June 2000);
- Completed four rounds of quarterly groundwater monitoring in June and October of 2000 and January and May of 2001 (Hart Crowser 2001); and
- Collected soil samples from Excavation 3 for total and TCLP analysis of DNT (October 2002).

Only one of the 26 soil samples submitted for chemical analysis from Excavations 1 and 2 contained detectable concentrations of DNT. Trench sample HC-EX1-T6 collected within the Excavation 1 area contained a total DNT concentration of 0.68 mg/kg. No soil samples collected from Excavation 2 contained detectable DNT concentrations. Relatively low concentrations (less than 0.7 mg/kg) of total DNT were detected in the Excavation 3 samples.

The first of the four rounds of groundwater sampling, which occurred in June 2000, encompassed a comprehensive suite of chemical parameters, including:

- Nitroaromatics/Nitroamines (EPA Method 8330);
- Dissolved Metals (arsenic, cadmium, chromium, copper, mercury, lead, nickel, and zinc);
- Total Petroleum Hydrocarbons (TPH - WTPH-G and D-extended);
- Volatile Organic Compounds (EPA Method 8260);
- Semivolatile Organic Compounds (EPA Method 8270); and
- Miscellaneous Inorganics (nitrate, ammonia, sodium chloride, sulfate, and total suspended solids).

Since chemical analytes were not detected above concentrations of concern during the first round of monitoring, the parameter list was reduced to nitroaromatics/nitroamines during subsequent sampling rounds (Hart Crowser 2001). No nitroaromatic/nitroamine compounds were detected in the June 2000 or October 2000 groundwater sampling rounds. In January 2001, well HC-MW-3 contained an estimated concentration of 7 ug/L total DNT. In May 2001, a sample from well HC-MW-3 contained 1.07 ug/L total DNT.

Hart Crowser completed a supplemental field investigation within the Drum Burial Area in 2002. Results of this investigation are summarized in a Hart Crowser letter report dated February 18, 2003. The primary objectives of this field investigation were to better define the extent of DNT in site groundwater and identify potential soil source areas (if any). As part of this task, 11 borings were advanced across the site using a direct-push drilling rig. One grab groundwater sample was collected at each boring location in July 2002. Groundwater was typically encountered at the site at depths of 15 to 16 feet below ground surface. Groundwater samples were also collected from the four permanent wells located within the Drum Burial Area (Figure 1-6). Groundwater samples were submitted for chemical analysis of nitroaromatics and nitroamines (EPA Method 8330), dissolved iron and manganese (to better define redox conditions), and total suspended solids (TSS).

DNT concentrations detected in Drum Burial Area groundwater were typically very low in the July 2002 sampling event. Only 3 of the 15 sampling locations contained detectable concentrations of DNT. Detected total DNT concentrations ranged from 0.0967 to 0.274 ug/L.

Once the groundwater sampling program was completed, Hart Crowser excavated 12 test pits around Excavation 3 and four locations in the Excavation 1 area. Soil sample analytical results obtained during this investigation confirmed that elevated concentrations of total DNT (less than 0.7 mg/kg) are present only within Trench 6 in the Excavation 1 area (Figure 1-6). Based on the lack of DNT in the seven other trench samples collected within Excavation 1, the occurrence of DNT in Excavation 1 appears to be limited in extent to the Trench 6 area.

An elevated concentration of DNT was also encountered in soils located along the eastern boundary of Excavation 3. Although total DNT at this sampling location was only reported at a concentration of 0.351 mg/kg, the relatively high toxicity characteristic leaching procedure (TCLP) DNT leachate concentration associated with the sample (98 to 190 ug/L) indicates that a greater amount of total DNT may be present. Given that DNT was only detected in one of the 32 samples collected within Excavation 3 during the 2002 sampling event, it appears that the DNT occurrence along the eastern boundary of Excavation 3 is relatively isolated.

Hart Crowser Site Wide Phase II Environmental Assessment, 2002 to 2003. A Phase II environmental assessment was conducted by Hart Crowser to evaluate environmental conditions on the Former Pacific Powder site (dated February 24, 2003). The field assessment focused primarily on evaluating groundwater quality beneath potentially impacted areas. As part of this investigation, 21 monitoring wells were installed at the following locations between November 18 and November 27, 2002:

- MEAN Plant (MP-MW1, MP-MW2, and MP-MW3);
- Powder Plant (PP-MW1, PP-MW2, PP-MW3, PP-MW4, PP-MW5, and PP-MW6);
- Old Nitrator Area (ON-MW1, ON-MW2, and ON-MW3);
- New Nitrator Area (NN-MW1, NN-MW2, NN-MW3, and NN-MW4);
- Mix House and Neutralizer House (MH-MW1 and NH-MW1, respectively);
- Culvert Plant (CY-MW1 and CY-MW2); and
- ABS Landfill (ABS-MW1).

Depending on the past history of the area of concern, the wells were sampled and analyzed for constituents of potential concern including TPH, volatile organics (VOAs), inorganics (including nitrate, ammonia, sulfate, sodium and chloride), glycols, nitroglycerin, nitroaromatics-nitroamines (NA/NA including DNT), semivolatile organics (SVOAs), pH, and metals. Two of the wells (PP-MW1 and PP-MW4) within the Powder Plant area were dry and could not be sampled.

Surface soil sampling was performed in areas where burning activities or heavy metal-containing herbicide applications (if performed) could have occurred (e.g., magazine sites). Surface soil samples were collected at the locations of the former Lab, Magazines, and Dynamite and Gelatin Houses, as well as at a depression in the Culvert Plant. Surface soil samples were generally analyzed for metals (except for Culvert Plant sample). Selected samples were also analyzed for NA/NA and SVOAs.

Results of the Phase II investigation indicated that site groundwater quality does not appear to be significantly impacted. No NA/NA, nitroglycerin, perchlorates, SVOAs, or VOAs (except for the probable lab contaminant methylene chloride) were detected in any of the 19 groundwater samples analyzed. The wells were placed in the inferred downgradient areas of identified explosives and culvert manufacturing areas. Diesel-range TPH was identified in groundwater in two locations: Powder Plant well PP-MW6, and MEAN Plant well MP-MW1. However, both TPH concentrations were below the Model Toxics Control Act (MTCA) Method A groundwater cleanup level of 0.5 mg/L.

Metals and conventional inorganic analytes were generally not detected at concentrations of potential concern. High concentrations of sulfate reported for samples collected at the Old and New Nitrator areas were considered suspect and were not verified in subsequent investigation (see **Groundwater Sulfate Sampling** section below).

Surface soil samples generally did not contain constituents at concentrations exceeding background conditions or MTCA cleanup levels. The concentration of diesel- and oil-range petroleum hydrocarbons in a surface soil sample collected at the Culvert Plant drainage depression exceeded Method A unrestricted cleanup levels. Arsenic concentrations in two of the 37 soil samples collected slightly exceeded the Method A unrestricted cleanup level. Detected lead concentrations ranged from 4 to 62 mg/kg, well below the Method A unrestricted cleanup level of 250 mg/kg and the MTCA ecological indicator soil concentration of 118 mg/kg.

Groundwater Sulfate Sampling within the Nitrator Areas, 2002 - 2003. During the Phase II groundwater sampling event (December 2002), elevated concentrations of sulfate (2,550 to 3,870 mg/L) were reported in groundwater samples collected from the Old and New Nitrator areas. These reported sulfate concentrations greatly exceeded concentrations (3.1 to 10.2 mg/L) encountered in other areas of the site during the Phase II investigation.

The reported sulfate concentrations in the Old and New Nitrator areas were inconsistent with other site data and were considered suspect. Although elevated sulfate concentrations could be caused by releases of sulfuric acid that were historically discharged to the Old Nitrator acid pond along with nitric acid, no other evidence of acid impacts was observed in the groundwater samples. Field measurements of pH for Old and New Nitrator groundwater samples ranged from 6.4 to 7.0 and were similar to values measured in other portions of the site. In addition, nitrate concentrations (which ranged from 0.5 to 1.4 mg/L) observed in the Old and New Nitrator area groundwater samples were not significantly elevated relative to other areas of the site and did not indicate a major release of nitric acid. It was suggested in the Phase II report that the elevated concentrations reported for sulfate in the Old and New Nitrator areas may be the result of laboratory error. Groundwater samples from the two areas were analyzed within the same laboratory batch and contained similarly high sulfate concentrations.

To evaluate whether previously reported groundwater sulfate concentrations for Old and New Nitrator wells were valid, three Old Nitrator wells (including ON-MW1, ON-MW2, and ON-MW3) and four New Nitrator wells (including NN-MW1, NN-MW2, NN-MW3, and NN-MW4) were resampled on March 31, 2003. Replicate groundwater samples were collected from each of the monitoring wells to allow samples to be submitted to two separate laboratories. One set of samples was sent to Severn Trent Laboratories (STL) in Tacoma, Washington, for analysis of sulfates using EPA Method 300A. STL performed the chemical analysis for sulfates during the Phase II investigation. The second set of samples was submitted to Analytical Resources Inc. (ARI) of Tukwila, Washington, for analysis of sulfates using EPA Method 375.2.

Sulfate concentrations observed in Old and New Nitrator groundwater samples during this second sampling event were much lower than the Phase II sample analytical results. Sulfate concentrations reported by both STL and ARI laboratories are fairly consistent (relative percent differences range from 6 to 36 percent) and are at least two orders of magnitude below the initial Phase II results. The highest sulfate concentrations were encountered in wells ON-MW1 (16.8 mg/L) and ON-MW2 (21.9 mg/L), which are both located downgradient of

the acid pond at the Old Nitrator. Concentrations of sulfate (4.3 to 7.2 mg/L) observed in the remaining wells within the Old and New Nitrator areas were similar to concentrations (3 to 10.2 mg/L) encountered in other portions of the site and to background concentrations for the southern Puget Sound area.

Aspect Consulting Soil Quality Characterization: Northeast Corner of Former Pacific Powder Property, 2004. Fifteen discrete surface soil samples were collected in January of 2004 to evaluate soil quality within a 72-acre area located in the northeast corner of the property. Ecology was concerned that this area may have been impacted by aerial deposition of particulates released by burning structures during the explosives plant decommissioning as well as possible site-wide use of arsenical herbicides.

Soil quality data obtained during this investigation indicate that the northeastern corner of the property has not been adversely impacted by release of metals from the former explosives manufacturing plant. Detected arsenic and lead concentrations in the soil samples ranged from 4 to 9 mg/kg and 4 to 13 mg/kg, respectively. The detected concentrations are within the range of Puget Sound natural background concentrations (as defined in Ecology's Natural Background Soil Metals Concentrations in Washington State, October 1994) and are below MTCA Method A soil cleanup levels for unrestricted land use for arsenic (20 mg/kg) and lead (250 mg/kg). The concentrations are also below MTCA ecological indicator soil concentrations for the protection of terrestrial wildlife (132 mg/kg and 118 mg/kg for arsenic and lead, respectively). Based on their review of the data, Ecology concluded that this portion of the property has not been adversely impacted and therefore no cleanup action is needed (letter from Mike Blum dated February 20, 2004).

1.3 Hydrogeologic Conditions

The uppermost geologic layers at the property are Vashon Drift containing, from youngest to oldest, recessional outwash, till, and advance outwash deposits. The Vashon recessional outwash typically contains unconsolidated sand, gravel, and cobbles, and has a high hydraulic conductivity. The till underlying the outwash is a very dense, gravelly, silty Sand and clayey, sandy Silt and typically is encountered 20 to 30 feet below grade at the property. However, the till is present at ground surface on the hills on the north side of the tracks. The thickness of the Vashon till varies from 0 to 17 feet across the central portion of the site. Penultimate glacial deposits (predating the Vashon deposits) are also present. The total thickness of glacial deposits in the outwash channel is estimated to range up to 130 feet.

Soils encountered during drilling of the Phase II monitoring wells typically included 1 to 4 feet of gravelly sand underlain by sandy gravel and cobbles to a depth of approximately 20 feet. Three borings (PP-MW1, PP-MW2, and PP-MW6) in the Power Plant Area were advanced to 24 to 30 feet below grade. In these borings, gravelly clayey silt was observed between depths of approximately 20 to 30 feet.

Groundwater elevations measured during the December 2002 sampling event indicate that groundwater flow is generally east to west (Figure 1-7). Depth to groundwater during sampling was typically 15 to 20 feet below grade. Groundwater flow directions observed during this Phase II sampling event are consistent with results previously reported by PGG. PGG determined that groundwater flow in June of 2002 was generally to the west along the southern half of the property, to the southwest in the northeastern corner, and to the northwest along the northwestern portion of the property.

1.4 Objectives

The objective of this RI/FS is to provide sufficient information, in combination with existing characterization information, to complete an evaluation of remedial alternatives for the site. To this end, specific objectives are to:

- Obtain data of sufficient quality and quantity to describe the physical and chemical properties of site soil and groundwater;
- Determine the nature and extent of contamination;
- Characterize the fate and transport of identified contaminants; and
- Evaluate the need and potential options for remedial actions.

This investigation will focus on further evaluating soil quality conditions associated with areas where dynamite was produced, transported, and handled. Previous field investigations and cleanup actions performed by Dyno primarily addressed ANFO and MEAN production and handling facilities, the Culvert Plant, and several burn pits/landfills (including the Drum Burial Area). In general, soil quality conditions associated with dynamite facilities that operated prior to 1969 are not as well characterized. As part of the Phase II investigation, groundwater quality within dynamite production areas (e.g., Old and New Nitrators, Neutralizer House, Mix House) was evaluated along with surface soil quality in the vicinity of dynamite and gelatin houses as well as magazines. To adequately characterize potential releases from dynamite production-related

facilities, additional soil quality investigations will be conducted. An additional round of site-wide groundwater sampling and analysis will also be conducted to supplement the existing groundwater data.

1.5 Scope of Work Elements

To develop a scope of work for a RI/FS, previous experience obtained from similar sites is typically used as a tool for identifying areas and contaminants of potential concern as well as focusing the field investigation. Within Washington State, the cleanup site most similar to Pacific Powder is the Former DuPont Works Site. The DuPont Works was an explosives manufacturing plant that operated from 1906 until the mid-1970s. There are a number of similarities and key differences between the DuPont and Pacific Powder operations. Numerous field investigations and cleanup actions have been performed at the Former DuPont Works Site as part of a consent decree with Ecology. The findings of these investigations, along with site-specific operational records for the Pacific Powder site, were used to help develop scope of work elements described below.

This RI/FS sampling program will consist of seven primary tasks:

- **Perform Explosive Hazard Assessment (EHA).** An EHA was performed by a qualified explosives expert (Ed Meeks of MWH Americas, Inc.) to assist in the development of the RI/FS Work Plan and in support of the Site-Specific Health and Safety Plan (SSHSP). The EHA report, which is presented in Appendix C, includes the following information:
 - Detailed review of historical information relating to site-specific explosive constituent manufacturing performed at the facility;
 - Construction details of similar explosive manufacturing facilities;
 - Results of a physical inspection of the facility and surrounding areas;
 - Identification of areas potentially impacted by explosive constituents; and
 - Recommendations to safely conduct the proposed RI field investigation.
- **Prepare RI/FS Work Plan.** Prepare this plan for soil and groundwater characterization for Ecology review and approval. The Work Plan consists of a Project Overview, a Sampling and Analysis Plan (SAP), a Quality Assurance Project Plan (QAPP), and a SSHSP.
- **Perform Pre-sampling Vegetation and Explosives Clearing Activities.** Many of the old roads and trails that provided access to former facilities at the site are

overgrown with Scotch Broom and other vegetation. It will be necessary to clear this vegetation to provide access to a number of the proposed sampling sites.

In areas where nitroglycerin was produced and handled within the Old and New Nitrator Areas (e.g., Nitrator Houses, Neutralizer House, Mix House, Nitrocotton House, Acid Pond, and Spent Acid Batch House), a preventative explosive clearing program will also be performed to minimize potential safety hazards during implementation of the RI/FS sampling program. The preventative explosive clearing program will be performed by qualified explosives experts in a manner that will minimize uncontrolled releases of potentially impacted soils and decrease the potential of field sampling personnel encountering unsafe working conditions. Hercules has suggested such a program and they have agreed to identify qualified experts to perform the explosive clearing activities. A scope of work for the pre-sampling explosive clearing program has been developed as part of the EHA (see Appendix C). In general the explosive clearing program will include:

- Pre-excavation soil screening using an aerosol-based explosive field-test kit (EXPRAY™);
- Excavation to expose identified former process structure foundations and/or areas believed to have been used for the manufacturing and/or handling of explosive material including the Old Nitrator, Neutralizer, NG gutter berm linking the Old Nitrator and Neutralizer, and Mix House locations;
- Identification of potential process drainpipes or surface drainage features involved with the manufacturing and/or handling of explosive constituents;
- Removal of identified former process structure foundations and process oriented drainpipes;
- Initiation of a sympathetic detonation program within specific areas (including New and Old Nitrators, Neutralizer House; Nitroglycerin Storehouse; Mix House, and Acid Pond); and
- Document pre-sampling explosive clearing activities.

Any debris and impacted soil or material encountered during foundation excavation activities will be segregated and securely stockpiled. Disposition of contaminated material is not part of this RI/FS.

- **Conduct Soil Sampling Field Work.** An extensive soil sampling program will be conducted to supplement the Phase II investigation and to further evaluate soil quality within the following areas:

- Narrow Gauge Railroad;
- Standard Gauge Railroad Spurs;
- Old Nitrator Area facilities (including the Motor Room, Nitrator House, Spent Acid Batch House, Acid Pond, NG gutter system, and Neutralizer House);
- New Nitrator Area facilities;
- Mix, Nitro Cotton, and DNT Melting Houses;
- Magazines;
- Suspected laboratory buildings;
- Farm House Burn Pit;
- Seismic Pond Area (temporary well point);
- Trailer storage and miscellaneous disturbed areas; and
- Area-Wide surface soil sampling.

The scope of work for the soil sampling program is discussed in greater detail in Section 2.1. Proposed and existing surface soil sampling locations are shown on Figure 2-1.

- **Conduct Groundwater Sampling and Elevation Monitoring Field Work.** To better understand groundwater quality conditions and flow directions at the site, an additional round of groundwater sampling and water level monitoring will be performed on the wells installed during the Phase II investigation (shown on Figure 1-7) as well as the four Drum Burial Area wells (HC-MW-1 through HC-MW-4). Four additional monitoring wells will also be installed and sampled, including two within the Drum Burial Area, one downgradient of the DNT Melting House, and one downgradient of the New Nitrator Area nitroglycerin storage area (Figure 2-2).

In addition to performing groundwater sampling and testing, the old existing plant wells (identified as PP#1 through PP#9) will be properly decommissioned. Prior to decommissioning grounding well PP#5, a depth-specific water quality screening program will be performed to verify that elevated conductivities and low pH conditions historically observed in the well are not representative of surrounding water quality conditions.

The scope of work for the groundwater monitoring program is discussed in greater detail in Section 2.2.

- **Prepare RI Report.** The results of the field investigation and previous site investigations will be summarized in the RI Report. The RI laboratory data will be validated and tabulated, and graphics will be developed showing areas of impacted soil and/or groundwater (if any). Soil and groundwater

quality data will be compared to screening levels including current MTCA Method A and B cleanup levels for unrestricted land use and MTCA ecological indicator soil concentrations for the protection of terrestrial wildlife. Results of this evaluation will be summarized in the draft RI document. A draft RI will be submitted to Ecology for review. Based on comments received, the draft RI will be revised.

- **Prepare Focused FS Report.** We will also perform a Focused FS to qualitatively evaluate remedial alternatives, including the effectiveness of the interim remedial action conducted in the Drum Burial Area. We will evaluate the cost and performance for each of the alternatives in accordance with WAC 173-340-350. Results of this evaluation will be summarized in a draft FS Report. A draft FS will be submitted to Ecology for review. Based on comments received, the draft FS will be revised, incorporated with the RI into a single document, and submitted to Ecology for public review and comment.

1.6 Schedule

The schedule for the RI/FS investigation and reporting activities will be outlined in the Agreed Order.